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ABSTRACT

The 1982 British Columbia Science Assessment was designed to gather information from the professional literature, review panels, interpretation panels, teachers, and students enrolled in grades 4, 8, and 12 (and a sample from grade 10). This pamphlet provides brief answers to nine questions related to the assessment. These questions focus on: (1) why the assessment was conducted; (2) who was involved; (3) how well student performance met provincial expectations in 1982; (5) a comparison of 1982 with 1978 results; (6) student attitudes toward science; (7) major findings; (8) major recommendations; and (9) uses of assessment data and results. Detailed achievement results, teacher questionnaire results, conclusions and recommendations are provided in a separate General Report. Highlights of the assessment, summary tables of important results, and conclusions and recommendations are provided in separate Summary Report. (Author/JN)

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Assessment Update

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NOVEMBER 1982

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BRITISH COLUMBIA SCIENCE ASSESSMENT 1982

The 1982 British Columbia Science Assessment was designed to gather information from the professional literature, review panels, interpretation panels, teachers, and pupils enrolled in grades 4, 8 and 12 (and a sample from grade 10).

Specific purposes were:

1. To establish baseline provincial and school district pupil achievement data on selected objectives rated as priorities in the current science curriculum guides.
2. To provide provincial and school district data on changes in pupil achievement on curriculum guide objectives in selected domains from the 1978 Science Assessment.
3. To develop a bank of B.C. curriculum-related items which can be used to develop achievement instruments for optional use by classroom teachers as part of their pupil evaluation.
4. To document current classroom practices and identify significant changes since the 1978 assessment.
5. To assess the extent to which change has taken place in non-achievement areas (e.g. facilities, attitudes) which were identified as concerns in 1978.
6. To identify the current context within which science curricula are used.
7. To examine initial reactions to changes/revisions/updates in science curricula since 1978.

This pamphlet provides brief answers to the following questions:

1. WHY was this assessment conducted?
2. HOW was the assessment conducted?
3. WHO was involved?
4. HOW well did pupil performance meet provincial expectations in 1982?
5. HOW does performance in 1982 compare to 1978?
6. WHAT are the attitudes of B.C. pupils towards science?
7. WHAT are the major findings of the Assessment?
8. WHAT is recommended by the Contract Team?
9. WHAT happens nex..

1. WHY WAS THIS ASSESSMENT CONDUCTED?

The main principle underlying province-wide assessments is that decisions about education should be based on up-to-date information. The 1982 Science Assessment was designed to provide information on a number of topics.

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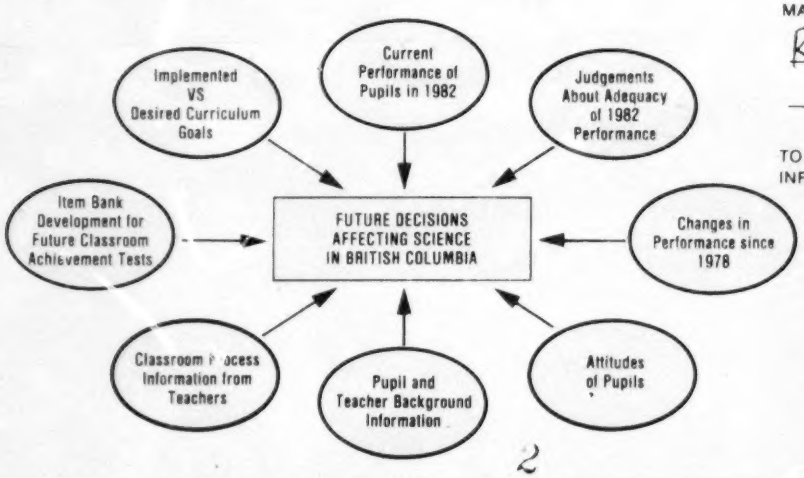
Implemented VS Desired Curriculum Goals
Current Performance of Pupils in 1982
Judgements About Adequacy of 1982 Performance
Item Bank Development for Future Classroom Achievement Tests
FUTURE DECISIONS AFFECTING SCIENCE IN BRITISH COLUMBIA
Changes in Performance since 1978
Classroom Process Information from Teachers
Pupil and Teacher Background Information
Attitudes of Pupils

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2. HOW WAS THE ASSESSMENT CONDUCTED?

MAJOR STAGES

April 1981
Contract awarded by Ministry to University of Victoria Team

May-August 1981
Development of draft copies of
- teacher questionnaires
- pupil achievement items
- pupil attitude items

August-September 1981
Teacher Review Panels examine items and questionnaires

October-November 1981
Achievement items, attitude surveys, and questionnaires piloted; information analyzed and final forms developed

December 1981-January 1982
Achievement forms and teacher questionnaires printed, packaged and distributed

February 1982
Teachers complete questionnaires

March 1982
Pupils in grades 4, 8 and 12 (and a sample from grade 10) complete achievement forms

April-May 1982
Analyses of data

June 1982
Interpretation Panels consisting of educators and members of the public judge pupil performance levels

July-September 1982
Provincial Reports prepared, reviewed, and finalized. Reports presented to the Ministry

November 1982
Publication of reports

3. WHO WAS INVOLVED?

The 1982 Science Assessment was managed by the Learning Assessment Branch of the Schools Program Division of the Ministry of Education.

The contract for this assessment was awarded to a team headed by Dr. Hugh Taylor of the University of Victoria. The Contract Team was guided by an Advisory Committee made up of teachers, administrators, a school trustee, and Ministry and Technical Agency representatives.

Members of the Contract Team were:

Hugh Taylor (Chair)	University of Victoria
Robert Hunt	Victoria
John Sheppy	University of Victoria
David Stronck	University of Victoria

Members of the Advisory Committee were:

Albert Haynes (Chair)	Learning Assessment Branch
David Bateson	Learning Assessment Branch
Mary Cooper	B.C. Research
Jack Corbett	Abbotsford
Barbara Holmes	B.C. Research
Marion Langdale	West Vancouver
Alan Littler	Sooke
Peter MacMillan	Barriere
Milton McLaren	Simon Fraser University
Ernie Norlin	Salmon Arm
Tom Robinson	Duncan
Hugh Taylor	University of Victoria
Elizabeth Welch-Wilson	Nelson

The Learning Assessment Branch would like to convey a heart-felt "THANK YOU" to all teachers who contributed in such a professional manner to the various phases of the Assessment!

AREAS OF RESPONSIBILITY DURING THE ASSESSMENT

Ministry of Education Learning Assessment Branch
- TERMS OF REFERENCE
- ADVISORY COMMITTEE
- TECHNICAL SUB-COMMITTEE
- PROVINCIAL REVIEW PANELS
- PROVINCIAL INTERPRETATION PANELS

Contract Team
- Instruments
  - achievement forms
  - affective scales
  - teacher questionnaires
- Reports
  - general report
  - summary report

Technical Agency
- Sampling
- Instruments
  - printing
  - distributing
  - collecting
- Analyzing data
- Consulting services

4. HOW WELL DID PUPIL PERFORMANCE MEET PROVINCIAL EXPECTATIONS IN 1982?

Pupil achievement in science was evaluated at three grade levels (4, 8 and 12) over three domains of cognitive behavior: processes, knowledge, and higher level thinking.

Achievement items were distributed over the domains as shown below.

DOMAIN	Number of Items at Each Grade Level		
	4	8	12
Science Processes	60	36	22
Knowledge — recall and understand	33	57	30
Higher Level Thinking	15	27	18

Three interpretation panels, comprised of educators, trustees, and members of the public, judged provincial performance on a five-point scale.

INTERPRETATION PANELS' RATINGS OF PUPIL PERFORMANCE

Scale: ST = Strong VS = Very Satisfactory S = Satisfactory M = Marginal W = Weak

DOMAIN -Objective	Grade 4		Grade 8		Grade 12	
	Mean Percent Correct*	Panel Rating	Mean Percent Correct	Panel Rating	Mean Percent Correct	Panel Rating
• SCIENCE PROCESSES	65	S	59	**	55	M
- Observe and Infer	75	VS	NA***		NA***	
- Quantify	60	M	NA		NA	
- Classify	65	S	67	VS	NA	
- Communicate	56	M	66	VS	NA	
- Interpret Data	NA***		56	S	53	M
- Identify and Control Variables	NA		45	W	57	S
• KNOWLEDGE — recall/understand	61	M	55	**	55	M
- Concepts	55	M	53	S	52	M
- Application/Nature of Science	67	S	50	M	60	S
- Safety Procedures	69	M	66	W	56	M
• HIGHER LEVEL THINKING	63	S	48	M/S	49	M
- Apply Concepts	58	S	50	S	58	M
- Use Rational and Critical Thinking	72	VS	46	M	45	M

* Mean Percent Correct is the average percent of correct responses to each set of questions within the objective or domain.

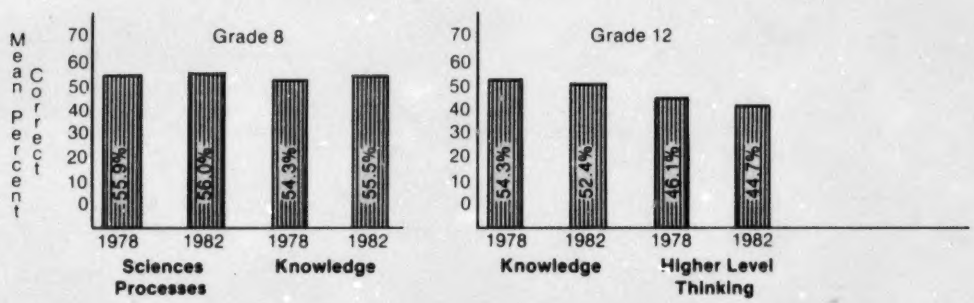
** No rating given because Panel members felt there was too much variance across ratings of the objectives within the domain.

*** Not Assessed.

5. HOW DOES PERFORMANCE IN 1982 COMPARE TO 1978?

To determine changes in pupils' achievement since the 1978 Assessment, several 1978 items, classified under change domains, were repeated in 1982 at each of the three grade levels. By examing the mean percent correct of responses to items in each category, trends were identified at two grade levels, 8 and 12. NO SUCH IDENTIFICATION was made at grade 4 because of a major change in administration of the instruments — in 1978, teachers read the items aloud, in 1982, pupils read the instruments.

The Contract Team reported that overall performance in 1978 and 1982 was very similar on items repeated in Grade 8. Pupil performance was judged to be satisfactory in both assessments. In grade 12, performance on repeat times is lower in 1982 by less than 2%. Even so, the 1982 Interpretation Panel rated the pupil performance higher.



6. WHAT ARE THE ATTITUDES OF B.C. PUPILS TOWARDS SCIENCE?

The achievement booklets contained a number of affective scales. The purpose of these scales was twofold: to provide effective instruments for teachers to use informally in assessing class attitudes, and to provide a base for measuring change in future provincial assessments. Some attitude trends evident across the grades were:

- overall attitudes towards science appear to be positive
- attitude towards the study of science in school declines from Grade 4 to Grade 12
- boys' attitudes towards science appear more positive than girls' attitudes towards science
- only one in five Grade 12 pupils would be prepared to enter a scientific career

7. WHAT ARE THE MAJOR FINDINGS OF THE ASSESSMENT?

Pupils' Achievement

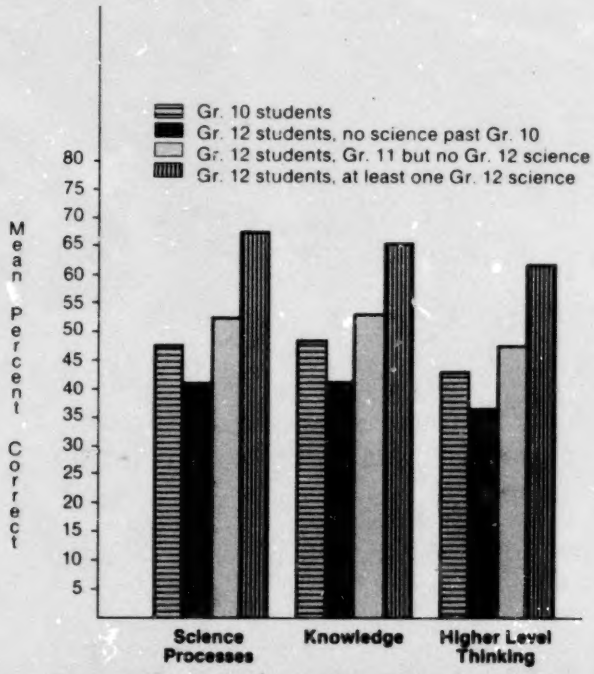
- Three domains were assessed at each of the three grade levels. The Interpretation Panels rated pupils' performance on two of the domains as Satisfactory, one was rated Marginally Satisfactory, four as Marginal and two received no rating due to large objective rating variance.
- The lowest overall rating at each grade level was given to the objective **Know Safety Procedures**. Very high performance was expected but was not attained. This low level of performance was a particular concern to the Interpretation Panels.
- In Grade 4, process and thinking skills appear to be adequately developed. Concepts appear to be underemphasized, perhaps due to lack of time spent teaching science in the primary grades.
- Pupils appear to be leaving elementary school with an adequate scientific background in the basics, but they are not showing adequate ability to integrate knowledge and processes.
- The Grade 12 picture is discouraging. No areas of achievement were assessed in which it could be said that the pupils were achieving well.
- As in 1978, sex-related differences in achievement generally favoured males. Only in the process domain at Grade 4 did girls outperform boys.
- Current Grade 10 pupils, and Grade 12 pupils with science courses beyond Grade 10, performed substantially better than Grade 12 pupils with no senior science courses.
- Performance on change items showed no difference in achievement at Grade 8 and a slight decline at Grade 12 level.

Teacher Questionnaires

- Many elementary and a number of junior secondary teachers consider themselves less than adequately prepared to teach science.
- Many elementary teachers are not spending the recommended time in teaching science.
- Almost one-half of all teachers surveyed expressed the need for extensive in-service and were willing to participate after school hours.
- Some progress has occurred since 1978 in the area of coordination, especially at the secondary level. However, one-half of the respondents still report no district level coordination in science.
- Elementary teachers still report (as they did in 1978) difficulty in the general areas of facilities and supplies. The situation has improved somewhat at the secondary level, but some problems are still being reported at the junior secondary level.
- Nearly all teachers of Biology 11 and 12 see a need for a curriculum revision.

Other Differences

- At all levels, pupils who most commonly spoke a language other than English had lower mean scores on all domains and objectives. Differences lessen and even disappear with increasing time within the schools and with the introduction of English in the home.
- Pupils whose post-secondary plans included scientific study achieved much higher than those who planned further study in non-scientific areas.



8. WHAT IS RECOMMENDED BY THE CONTRACT TEAM?

The Contract Team's recommendations were split into two levels, those "of highest priority" and "further recommendations".

Recommendations: Of Highest Priority

Recommendation 1

That the Program Inplementation Branch of the Ministry of Education coordinate the design, development and delivery of in-service programs which will focus on the following areas of need:

- *how to teach science processes and critical thinking skills*
- *the development of an adequate background of science knowledge in areas stressed in the curriculum, in areas of weakness for elementary teachers, and in the physical and earth/space sciences for junior secondary teachers*
- *how to safely teach science*
- *how to teach safety to pupils*

Recommendation 2

That the following actions be taken with respect to the pre-service training of teachers:

- *the Faculties of Education should revise teacher education programs as needed to ensure that:*
  - *(i) all pre-service elementary teachers experience science study to a minimum of a 3-unit course or equivalent at the university/college level, and*
  - *(ii) all pre-service elementary teachers take a course in science teaching methodology*
- *the Faculties of Education should give greater emphasis to each of the techniques and topics identified by teachers to be most inadequately emphasized in their pre-service training*
- *the Ministry of Education should revise certification guidelines to reflect the above*

Recommendations: Further

Recommendation 3

That the Ministry of Education establish safety standards for school science classrooms, and provide funds for school districts not only to conduct surveys of the science safety equipment in schools where science is taught, but also to correct deficiencies that may be discovered through such surveys

Recommendation 4

That the Curriculum Development Branch of the Ministry of Education establish a Senior Secondary Biology Revision Committee to re-examine all aspects of the senior secondary biology curriculum

Recommendation 5

That school districts:

- *evaluate the form of science coordination within each school and establish some form of school level coordination where none now exists*
- *not currently providing science coordination appoint or designate a qualified individual or individuals to be responsible for coordination and leadership of the science programs within the district*

Recommendation 6

That school districts:

- *investigate the potential for converting some existing elementary general classrooms into rooms with adequate science facilities*
- *examine elementary schools for ways to utilize available space so that central storage and preparation space is available for science teaching*
- *attempt to provide for adequate ventilation, storage space for volatiles, increased general storage space for equipment and increased space for storage of pupil projects where these are needed in schools*
- *examine the quantity and quality of the materials and equipment used in their science programs, and make a determined effort to effect improvements where these are necessary, especially in elementary schools and small junior secondary schools*
- *encourage school libraries to purchase an adequate supply of science reading materials in both elementary and secondary schools*

Recommendation 7

That, whcrever possible, school districts and administrators avoid assigning teachers with little science background to teach science in junior secondary grades. Where teachers must be reassigned outside their specialty, provisions should be made for retraining

Recommendation 8

That school administrators and teachers follow the time allocations given for science instruction in the Administrative Handbook

Recommendation 9

That teachers and school librarians cooperatively explore the upgrading of print materials in libraries and classrooms at both the elementary and secondary levels

Recommendation 10

That junior secondary teachers give greater time emphasis to earth science topics

Recommendation 11

That science teachers:

- *ensure that pupils understand safe procedures appropriate to their level*
- *give pupils more practice in presenting results in symbolic forms (especially graphs) and in interpreting such forms*
- *give extensive time (particularly in elementary schools) and emphasis to measurement and quantification skills and to the use of the metric system*
- *give pupils in upper elementary grades and secondary schools adequate experience in analyzing variables and designing controlled experiments*
- *give more emphasis to teaching the practical applications of science knowledge and to using that knowledge in new situations*

9. WHAT HAPPENS NEXT?

Results of the 1982 Science Assessment are now available for use. Some examples of ways the results will be used are:

PROVINCIAL LEVEL

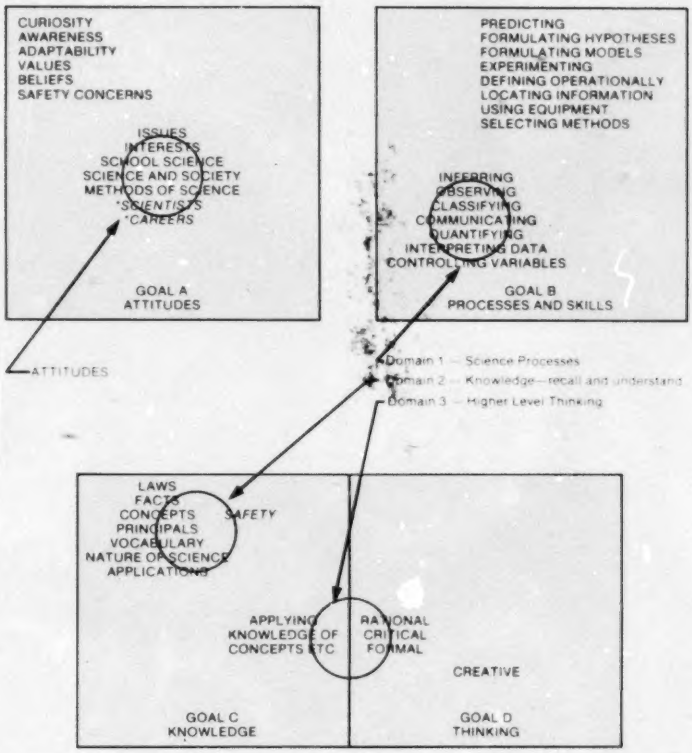
This assessment preceded the introduction of a new curriculum in junior secondary science, and follows a revised curriculum in elementary science. This assessment has provided baseline data which will be used in future assessments to help judge effectiveness of the new curricula.

QUESTIONS

Any individual or group desiring clarification, discussion, assistance or advice on any aspect of the assessment should contact the Learning Assessment Branch.

OTHER LEVELS

Other groups which will find the Assessment results a source of important and relevant information include: School Districts, local teachers' associations, professional development groups, and teacher educators. Interested groups should examine the reports and recommendations, and submit their reactions to the Ministry.



Curriculum goals and assessment domains

The circled areas in the above chart indicate assessment domains selected from the full range of curriculum goals stated in the curriculum.

* not specifically listed as curriculum goals

The GENERAL REPORT and the SUMMARY REPORT of the Science Assessment were released in November, 1982. The SUMMARY REPORT presents highlights of the project, summary tables of important results, and conclusions and recommendations made by the Contract Team.

The SUMMARY REPORT was distributed to school district offices in sufficient quantities to provide one copy to each school. Copies were also sent to universities and colleges, and to other educational institutions.

The GENERAL REPORT includes chapters detailing achievement results, teacher questionnaire results, and the conclusions and recommendations from the Contract Team. In-depth discussion of data occurs in each chapter. The distribution of the GENERAL REPORT is limited because of the technical nature of its contents.

Additional copies of these reports, in limited numbers, are available along with additional information from:

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